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ABSTRACT

Both the occupational analysis program and the management engineering program are primarily concerned with task level descriptions of time spent to perform tasks required in the Air Force, the first being personnel specialty code oriented and the second being work center oriented. However two separate and independent techniques have been developed to measure time and identify tasks that are performed. The purpose of the study was to identify and evaluate areas in which Air Force Management Engineering Teams (MET) might benefit from occupational research data. For the study occupational research data was provided as a supplemental input to the development of MET engineered manpower standards for base level Data Automation. The analysis revealed that the techniques used by MET and occupational analysis yield essentially the same information. Also a number of areas were identified in which occupational research data and techniques could be beneficially employed by MET. (Author/SA)

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## POTENTIAL USES OF OCCUPATIONAL ANALYSIS DATA BY AIR FORCE MANAGEMENT ENGINEERING TEAMS

By

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July 1974
Interim Report for Period 7 January 1973 – 28 February 1974

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The purpose of this study was to identify and evaluate areas in which Air Force Management Engineering Teams (MET) might benefit from occupational research data. For the study occupational research data was provided as a supplemental input to the development of MET engineered manpower standards for base level Data Automation. The analysis revealed that the techniques used by MET and occupational analysis yield essentially the same information. Also a number of areas were identified in which occupational research data and techniques could be beneficially employed by MET.

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# POTENTIAL USES OF OCCUPATIONAL ANALYSIS DATA BY AIR FORCE MANAGEMENT ENGINEERING TEAMS

## I. INTRODUCTION

This study was requested by HQ USAF, Manpower and Organization, to determine the potential uses of occupational analysis data by management engineering teams. The impetus for the study was the fact that both the Occupational Analysis Program and the management engineering program are primarily concerned with task level descriptions of time spent to perform tasks required in the Air Force. Because of the genealogy of the two programs, two separate and independent techniques had been developed to measure time and identify tasks that are performed.

### The Management Engineering Program

The USAF management engineering program (MEP) is a function of Manpower and Organization. The objective of the program is to determine manpower requirements and systematically improve the distribution and utilization of manpower resources. According to AFM 25-5, which establishes the policies and procedures for the management engineering program, "The MEP is the primary capability for accurately determining manpower requirements for the Air Force." The development of techniques and definition of these requirements is a priority goal of the Air Force. The objectives of the MEP are carried out through each major commmand and at each base by the management engineering team (MET). The MET is responsible for developing manpower standards which define manpower requirements, and the distribution of grade and skill level within the manpower authorizations. One technique commonly used by MET in developing manpower requirements is the development of an "engineering standard." An engineered manpower standard is defined in AFM 25-5 as:

> An engineered manpower standard is a HQ USAF-approved, quantitative expression of manpower, by grade and Air Force Specialty Code, required to accomplish prescribed tasks and activities at varying levels of workload volumes. The predominant data inputs are derived from time study, queueing, work sampling, standard data, or predetermined time systems and meet the statistical reliability requirements. . .

The specific procedures used by a MET in developing an engineered standard are described in Figure 1. The scheduling for development of engineered manpower standards is done by the Major Air Commands in coordination with HQ USAF. In scheduling the manpower standard, suspense dates are assigned for each phase of the study and the final report to allow MET to program their resources. During the preliminary phase precise definitions of the work process (tasks) are developed for the work center activity. The tasks identified are used to develop a "Work Center Description" which defines the work activity for each work center. The work center description in the preliminary report is then reviewed by the office of primary responsibility (OPR) for adequacy and completeness and must be approved prior to the work measurement phase. During the work measurement phase, detailed data collection is conducted on site. This is the prime element of the process. The data are collected in categories defined in "the Work Center Description" in accordance with the preliminary report. The measurement phase lasts a minimum of 15 days or one complete work cycle. The goal of the measurement phase is to obtain the best possible estimate of the amount of time it takes to complete the tasks required in the work center. The computation phase consists of identifying the best functional relationship between the sampled work requirements and independent work load factors. If the relationship meets the statistical requirements defined in AFM 25-5, the workload factors are then used to develop a manning table which gives the number of authorizations for differing workloads. In addition, the MET ascribes Air Force Specialty Codes (AFSC), a skill level, and a grade to each authorization. The determination of the appropriate AFSC and skill requirements is completed through guidance from HQ USAF and close coordination with the OPR. At the end of the computation phase a final report is submitted through the Major Command to HQ USAF for approval.

### The Occupational Analysis Program

The function of the Occupational Analysis Program is defined in AFM 35-2 as:

> The occupational survey and Air Force specialty evaluation procedures are designed to secure information for maintaining the Air Force occupational structure as defined in AFMs 36-1 and 39-1, updating specialty training programs, and

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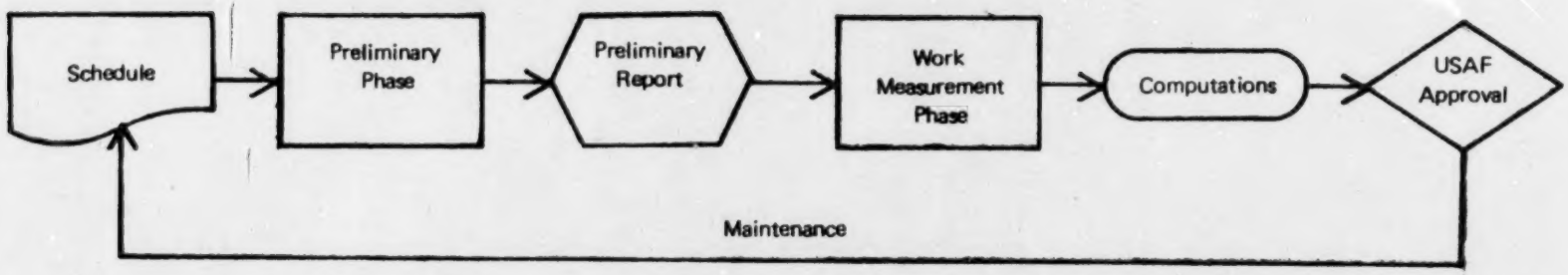


*Figure 1.* **Development procedures for Engineered Manpower Standard – adopted from AFM 25-5, Figure 3-2.**

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determining rank-ordering of Air Force specialties based on the relative complexity of the specialty requirements. The tasks performed by Air Force personnel are constantly changing with the introduction of new equipment and evolvement of new methods. Often these changes generate a need for establishing new specialty identification and shred-outs, or eliminating obsolete identification. Occupational survey information provides guidance for effecting changes in the occupational structure.

The Air Force method of occupational analysis makes use of Air Force-wide occupational surveys for the collection of quantitative data directly from job incumbents who describe their job within the specialty area. In completing the occupational survey, each incumbent supplies identification and background data and checks those tasks which are part of his present job. He then rates the tasks he checked on a 7-point scale indicating the relative amount of time spent on each task compared to all other tasks performed. The ratings range from 1 (very much below average) to 7 (very much above average) with 4 being a mid-point (about average).

The techniques for conducting occupational surveys and analysis are reported in a series of research reports dating back to 1958. Past research and continuing experience with survey data derived from the job task inventory indicate that this technique produces highly reliable information about existing Air Force jobs.

Air Force occupational surveys are authorized under AFM 35-2, *Occupational Analysis*. The job surveys are part of the Air Force Personnel Testing Program and are routinely developed and analyzed by the Occupational Measurement Squadron of Air Training Command. The computer analysis system, Comprehensive Occupational Data Analysis Programs (CODAP), developed for use in the analysis of occupational survey data consists of almost 50,000 program instructions and is fully documented only in technical systems manuals.

### A Comparison of the Programs

Although the goals of the two programs are different, they are compatable. Both are primarily concerned with the efficient use of human resources, with MEP being work center oriented and the occupational analysis being personnel specialty code oriented. Both programs are tasked with developing work descriptions. The MEP description is based on what tasks are required to perform a job, in broad task categories, while occupational analysis describes what job is being performed at a finer task level. Both programs include time measurement as an integral part of their work measurement system. The MEP frequently uses work sampling by trained management engineering technicians reported in absolute hours and fractions of hours while the occupational analysis program has job incumbents report the relative amount of time which is then converted into a percent time scale. The MEP measures both productive and non-productive time, while the job survey technique incorporates only productive tasks. The purpose of this research was to determine if the two programs are compatible during any phase of an Engineered Manpower Standard study, and where compatibility does exist, determine the utility of using occupational analysis data in conjunction with or in lieu of current MEP techniques.

## II. METHOD

The sample selected for this study was the base level data automation work centers at selected bases in the Military Airlift Command (MAC). These work centers were selected because of the size of the ME study (N≈350) and the currency of occupational survey data on the Computer Systems Career Field (511XX) which comprized over 95% of all personnel in the work center. It was decided through early coordination between the Occupational Research Division (Air Force Human Resources Laboratory) and the lead management engineering team that, since this was a feasibility study, the optimal approach would be for the MET to follow its normal standardized procedures while the occupational analysis data would be provided as a supplemental input for use by the MET. In addition to the routine data collected on the Computer Systems Career Field, occupational surveys were readministered to all personnel within the work centers that comprized the MET study. Routine CODAP analysis were then provided to the MET along with explanations of the data. The MET would make additional request for any occupational research data that appeared promising to them. In addition, work sampling data was provided by MET to allow validity checks on the occupational analysis time spent data. Basically, as much flexibility as possible was built into the approach to capitalize on any aspect of the study that showed promise.

## III. DATA ANALYSIS AND RESULTS

Data analysis for all job incumbents in the MAC data automation function was completed using the CODAP programs. As a first step in the CODAP

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analysis, the computer converts each individual's relative time-spent responses (1-7 scale) to percent time ratings. To obtain the percent time ratings, all of an incumbent's time-spent ratings are summed and the total thus represents 100% of the time spent on the job. Each rating is then divided by the total and the quotient multiplied by 100 to give a percent time spent estimate on each task. For the purpose of organizing jobs into similar units of work, an automated job-clustering computer program was used. This hierarchical-grouping program (Christal & Ward, 1967) forms a basic part of the CODAP system for job analysis. The computer compares each individual with every other individual in the sample in terms of percent time spent on each and every task in the inventory. The computer locates the two persons with the most similar jobs and combines them to form a group with a composite job description. In successive stages, the program adds other members to this group or forms new groups based on similarity in the percent of time spent on tasks. This procedure is continued until all individuals and groups are combined to form a single group. At each stage of the grouping process an index of homogeneity is calculated. This index, percentage of work overlap of group members, is explained by Archer (1966). The index serves as an estimate of the overlap of work that would be expected if a member of the group was randomly reassigned to a job in that same group.

Figure 2 is a summary of the hierarchical grouping analysis. The titles used are based on the individuals own job titles obtained in the background information section of the job inventory. For each of these major groups a duty task description was obtained and provided to MET to assist them in the development of their work center description. In addition, for each of the seven bases included in the MET study, separate job descriptions were provided to identify any unique tasks being performed. The only unique tasks identified had to do with the operation of minor peripheral equipment, such as a paper tape reader that some bases used and other bases either did not have or did not use.

The MET identified each task in the job inventory as belonging to one of their job categories; this information was used to combine the time spent estimates from the job inventory to make comparisons with the work measurements obtained by MET. The MET time estimates were converted to a percent time scale to make direct comparisons possible. The correlation obtained between the job inventory estimates of time spent and the measured time provided by MET was .7912 with N = 1,784 (this correlation is for all categories of time measured for each individual in the sample). This is extremely high considering the subjective placement of tasks into the MET work center descriptions and the divergence of the methodologies for development of the time spent ratings. With these considerations taken into account, it can be said that both methodologies are clearly measuring the same job performance.

Besides the analysis of the MAC job incumbents, a number of additional products were produced from the data on the Computer Systems Career Field (AFSC 511XX) collected by the Occupational Measurement Squadron. One of these analysis consisted of an across command comparison of work performed in the base level data automation function. The results of this analysis are included in Table 1. The values in the table represent percent overlap which was explained earlier. Basically, the higher the values, the more similar are the tasks being performed. As can be noted from the table, the jobs performed at all commands in the Continental United States (CONUS) are more similar than all non-CONUS commands. In addition, it appears that the Strategic Air Command (SAC) is the most representative of all commands for this functional area.

The other data used from the Occupational Measurement Squadron study was related to a number of variables that were thought might be useful in determining grade and skill level requirements. While none of these indicators could give exact skill or grade conversions based on job content, it was felt that the variables could be used to give a feel to the MET in determining appropriate grade and skill level based on job content.

## IV. DISCUSSION AND RECOMMENDATIONS

The hierarchical grouping summary in Figure 2 provided some interesting insight into the organizations under study. The organization chart for the base data automation function is shown in Figure 3. However, by referencing Figure 2, it appears that there is no real difference between jobs performed in Management (FC1542) and Control (FC1541). This information was provided to MET together with the forecast that the MET would have a great deal of difficulty differentiating between the two work centers. This was

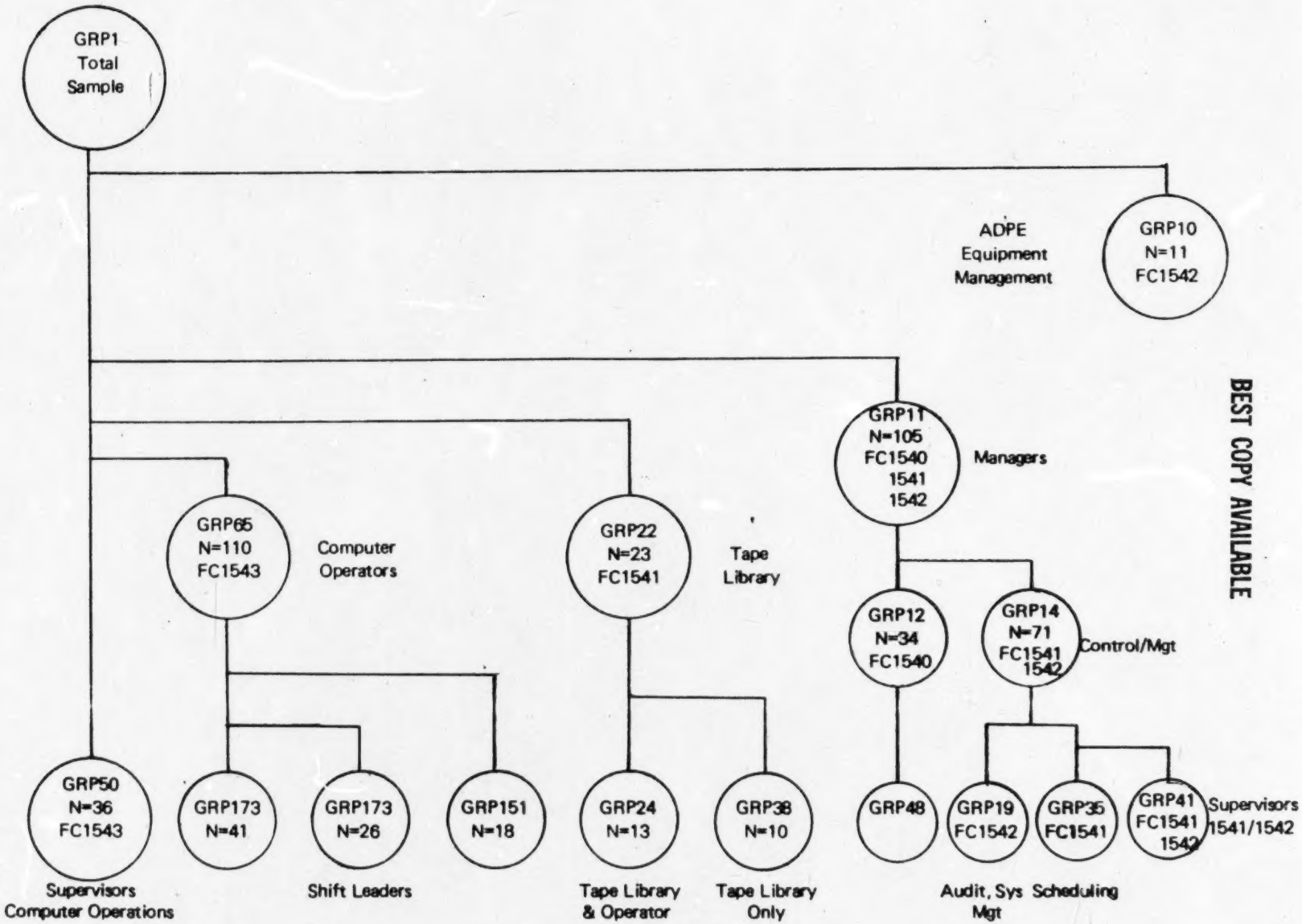


*Figure 2.* **Diagram of hierarchical grouping.**

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*Table 1.* **Overlap of Task Performance for Job Incumbents Across Nine Commands**

| Command | AAC | ADC | USAFE | AFSC | ATC | MAC | PACAF | SAC | TAC |
|---|---|---|---|---|---|---|---|---|---|
| AAC | 100.00 | 63.34 | 69.15 | 62.13 | 64.35 | 59.36 | 68.92 | 67.79 | 62.48 |
| ADC | 64.34 | 100.00 | 72.45 | 73.47 | 71.36 | 70.88 | 68.00 | 76.04 | 72.79 |
| USAFE | 69.15 | 72.45 | 100.00 | 71.24 | 68.20 | 63.20 | 70.94 | 74.53 | 66.52 |
| AFSC | 62.13 | 73.47 | 71.24 | 100.00 | 76.28 | 76.96 | 70.70 | 81.12 | 80.95 |
| ATC | 64.35 | 71.36 | 68.20 | 76.28 | 100.00 | 77.70 | 72.17 | 82.69 | 81.15 |
| MAC | 59.36 | 70.88 | 63.20 | 76.96 | 77.70 | 100.00 | 70.01 | 82.13 | 84.23 |
| PACAF | 68.92 | 68.00 | 70.94 | 70.70 | 72.17 | 70.01 | 100.00 | 75.73 | 70.94 |
| SAC | 67.79 | 76.04 | 74.53 | 81.12 | 82.69 | 82.13 | 75.73 | 100.00 | 85.03 |
| TAC | 62.48 | 72.79 | 66.52 | 80.95 | 81.15 | 84.23 | 70.94 | 85.03 | 100.00 |

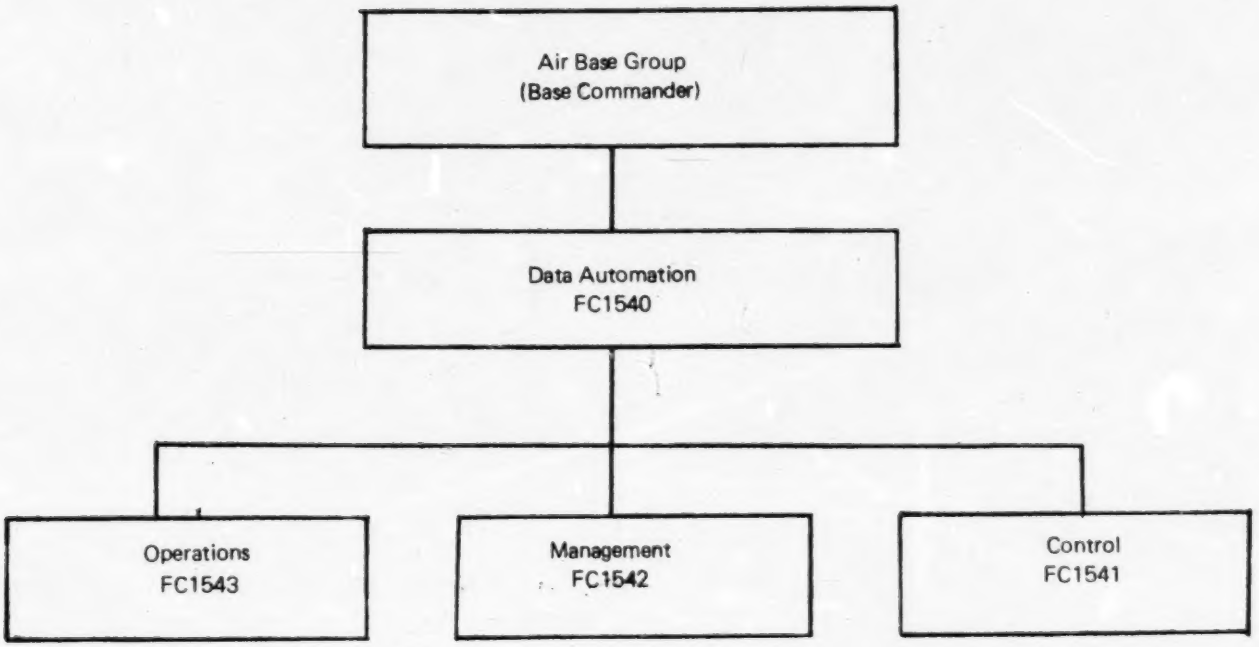


*Figure 3.* **Organization chart for base data automation.**

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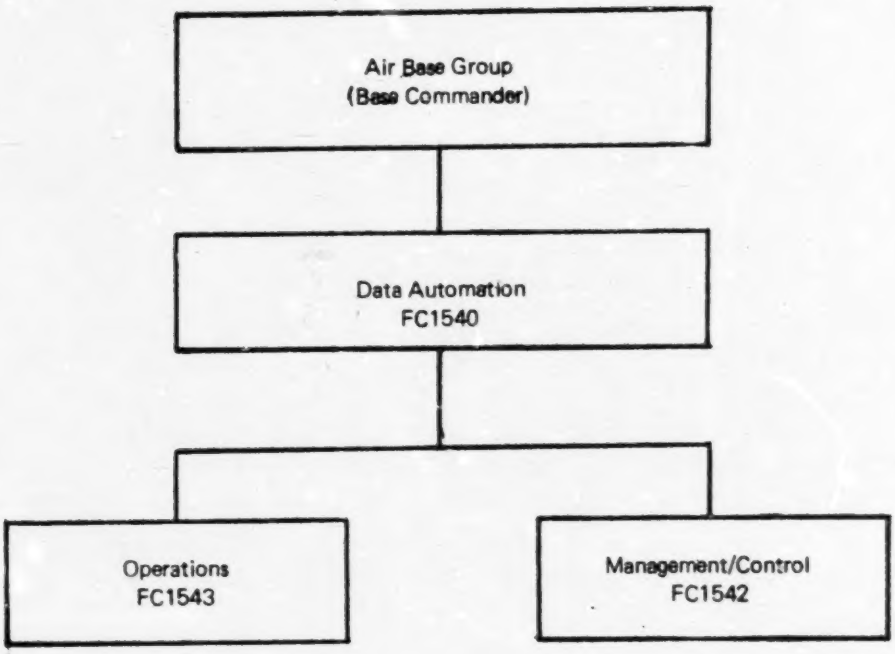


*Figure 4.* **Proposed organization chart for base data automation.**

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verified in the field during the measurement phase. By using the hierarchical grouping, the organizational chart in Figure 4 is based on task performance. This organizational structure was verified independently by the MET and appears in their final report on the work center. Although task performance has often been referenced as a critical variable in organizational structure, this is the first effort in which task level data has been effectively used to determine needed organizational restructuring.

In addition to being of assistance in the area of organizational structuring, and the ability to forecast certain problem areas in the measurements at a work center, the job descriptions appear to be extremely useful in the development of work center descriptions. It is felt that by using current job descriptions developed from job inventory information, significant savings in man-hours can be realized by MET during the preliminary phase. It is recommended that further research be done pursuant to this goal.

The comparisons between commands of all data automation work centers seems to have a great potential pay off. In addition to being utilized by MET to review efforts by other commands it may be of utility to Air Force in (*a*) scheduling commands for development of manpower standards and (*b*) as an aid for determining where an Air Force standard would be more appropriate than a command standard. If the data in Table 1 had been available prior to the development of any standards in the data automation function, it would appear that SAC would be the most appropriate (i.e., most representative) command for development of a standard. Then, by use of a statistical standard or operational audit of some type, the validity of the SAC standard could be determined. This type of procedure could result in significant manpower savings within the MEP and allow METs to be responsive to other requirements. Table 1 also shows that if any exceptions to the SAC standard are present, they most likely will be in the Alaskan Air Command (AAC). Thus, by scheduling an engineered standard for SAC and perhaps AAC, and a statistical standard for all other commands, an Air Force Standard could be developed for less cost to the MEP. It is recommended that this type of information be made routinely available to the Air Force Manpower and Organization Office, as well as to the METs. In addition, to provide the best possible data for this purpose, it is recommended that the Occupational Measurement Squadron routinely obtain functional code identifiers for all job inventories. It is anticipated that this would not only be a service to MEP but would also aid analysts in completing the occupational analysis.

In the area of grade and skill level requirements a number of variables were provided MET as an aid in determining authorizations. Unfortunately, no technology currently exists for making valid determinations of grade and skill level requirements for airmen. The variables used were, however, of some benefit, although at best only crude estimates of existing requirements. Because of the importance of this to the MEP and since the Occupational Research Division has had previous success in the determination of officer grade requirements (Christal, 1965; Brokaw & Giorgia, 1966), it is strongly recommended that a vigorous research program be instigated to test and develop a valid technology for determining grade and skill requirements for officer, enlisted, and even civilian Air Force personnel. Such research is expensive both in manpower and time but the potential pay off more than negates these expenses.

It appears that there are a number of areas in which occupational analysis data is of benefit to the MET. However, a word of caution needs to be inserted. Occupational analysis data is AFSC specific; thus it would probably be of less value for work centers that have a wide variety of AFSC's present. Also, the smaller the work center in absolute size, the smaller the value of the occupational data. The converse of this is also true; that is the larger the size of the MET study and the more homogeneous the AFSC's that are involved, the greater should be the pay off of using occupational research data. This is encouraging since the larger the study, the greater the savings that can be realized by the use of the data.

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